PHYSICS (9^{TH}) – ENGLISH MEDIUM

Chapter 3: DYNAMICS

Question 1: What is meant by the dynamics?

The branch of the mechanics that deals with the study of motion of an object and the cause of its motion is called dynamics.

It deals with the laws of the motion, role of the mass in the motion and the effects of the forces acting on it.

Question 2: Define force and write its SI units?

A force is that agent which moves or tends to move a body or stops or tends to stop the motion of body.

Unit: Its SI unit is N which is equal to $kgms^{-2}$

Question 3: Define inertia.

That characteristic of a body due to which a body opposes any change in its state of rest or motion, is known as the inertia.

1) It is the function of the mass of the body.
2) It is directly related to the mass of the body. It means greater the mass, greater will be the inertia.

Question 4: When card flicks away from a glass why coin drops into the glass?

When card flicks away, coin remains undisturbed as it retains its state of rest due to its inertia and falls into glass.

Question 5: Define momentum. Write its unit and formula.

The quantity of motion of a body due to its mass and velocity is called momentum. It is expressed as P

Formula: P=m v

Formula shows that product of mass and velocity of a body is equal to momentum.

It is vector quantity whose unit is $kgms^{-1}$ or Ns.

Question 6: What is the law of the inertia? OR state first law of motion.

A body in rest or in uniform motion in a straight line will remain in its state of rest or uniform motion, until an external force acts upon it.

1) It is also known as the first law of the motion.
2) It is about the static body or bodies moving with uniform velocity in a line.

Question 7: What is Newton's second law of motion? Write its equation.

When a force acts upon a body, acceleration is produced in the direction the force**.** The magnitude of the acceleration is directly proportional to the magnitude of the net force acting on it and inversely proportional to its mass.

Equation: F=m a

Question 8: 20N force is producing an acceleration2ms^{-2}.what is the mass of the body?

Given: **F=20N**

a=2ms^{-1}

Required: **Mass of body=m=?**

Solution: **According to 2nd law of Newton**

F=ma

$$\Rightarrow \quad m = \frac{F}{a}$$

$$m = \frac{20}{2}$$

$$m = 10kg$$

Question 9: Prove that: F=ma

According to motion's 2nd law of Newton. "When force acts on a body acceleration is produced in the direction of force.

(i). Acceleration is directly proportional to force:

$$\therefore a \propto F ....(i)$$

(ii). Acceleration is inversely proportional to mass.

$$\therefore a \propto \frac{1}{m} ....(ii)$$

On combining eq. (i) and (ii).

$$a \propto \frac{F}{m}$$

$$a = (constant)\frac{F}{m}$$

$$a = K\frac{F}{m} \qquad (\because K = 1)$$

$$a = (1)\frac{F}{m}$$

$$a = \frac{F}{m} \Rightarrow F = ma$$

Question 10: Define SI unit of force OR define Newton.

The SI unit of force is newton (N) defined as,

"One newton is the force that produces acceleration of $1ms^{-2}$ in body of mass of 1kg."

Question 11: A body of the mass 8 kg has a force of 20 N. What is the acceleration in the body?

Mass of body=m=8kg

F=20N

a=?

According to 2nd law of Newton

F=ma

$$a = \frac{F}{m}$$

$$a = \frac{20}{8} \Rightarrow a = 2.5ms^{-2}$$

Question 12: How much acceleration will be produced by a body of the mass 50 kg while a force of 100N is acting on it?

Mass of body=m=50kg

F=100N

a=?

According to 2nd law of Newton

F=ma

$$a = \frac{F}{m}$$

$$a = \frac{100}{50} \Rightarrow a = 2ms^{-2}$$

Question 13: Find the value of the force which produces an acceleration of $2ms^{-2}$ in a body of mass 4kg?

m=4kg

$a=2ms^{-2}$

F=?

Solution: **According to 2^{nd} law of Newton**

F=ma

F= (4) (2)

F=8N

Question 14: Write the difference between the mass and weight?

MASS	WEIGHT
1) Amount of matter in a body is known as the mass.	**1)** The force by which earth attracts everything towards its center is called weight.
2) It remains same everywhere.	**2)** It depends upon the "g", therefore it changes by changing the position.
3) It is a scalar quantity.	3) It is a vector quantity.
4) It is found by comparing with the standard masses in the balance.	4) It is measured by the spring balance.
5) Its unit is kg.	5) Its unit is newton, N

Question 15: How much force is required to stop a body of 10kg from falling?

Given data: **m=10kg**

$g=10ms^{-2}$

Required **F=?**

Solution: **as we know that**

W=F=mg

F= (10) (10)

W=F=100N

Question 16: A body has a weight of 147 N. What is its mass?

Given data: **W=147N**

$g=10ms^{-2}$

Required **m=?**

Solution: **as we know that**

W=mg

$$m=\frac{W}{g}$$

$$m=\frac{147}{10}$$

$$m=14.7kg$$

Question 17: Explain the Newton's third law of the motion and give example.

According to the third law of the motion, every action has a reaction .Action and reaction are equal in magnitude but opposite in direction. They always act on the different bodies.

Example:

1) Rocket motion.
2) A book on the table.

Question 18: If a body is drawn by the two opposite forces of100N. How much tension will be produced?

If a body is drawn by the two opposite forces of100N, the tension in it is 100N.

If a body is exerted by the two equal and opposite forces, the body does not move. So, one force acts like action and other acts like the reaction

T=F=100N

Question 19: What is the difference between the action and the reaction?

Action	Reaction
1) When a body A exerts a force on another body B, then this force by object A is known as the action. **2)** Weight of book lying on the table is action of book.	1) The forces produced due to action is called Reaction. **2)** The table exerts a reaction force on the book equal to weight of book.

Question 20: What is the relation of the force with the change in momentum? Derive its equation.

According to 2nd law of motion.

F=ma

$$F = m\left[\frac{Vf - Vi}{t}\right] \qquad \because \left[a = \frac{Vf - Vi}{t}\right]$$

$$F = \frac{mVf - mVi}{t}$$

$$F = \frac{Pf - Pi}{t} \qquad \left[\begin{array}{l} \therefore Pf = mVf \\ \therefore Pi = mVi \\ \therefore Pf - Pi = \Delta P \end{array}\right]$$

$$F = \frac{\Delta P}{t}$$

$$F = \frac{\text{Change in momentum}}{\text{Time}}$$

F= Rate of change of momentum.

Hence Force is equal to the rate of change of momentum in a body.

Question 21: What is the law of conservation of the momentum?

The momentum of an isolated system containing two or more colliding bodies, always remain conserved.

Numerical form: Total momentum of the system after collision=Total momentum of the system before collision

$$M_1V_1+M_2V_2= M_1V_1'+M_2V_2'$$

Example: Rocket and jet engine work on the law of conservation of the momentum.

Note: The total momentum of an isolated system is always zero.

Question 22: Why there is a backward jerk when a gun is fired?

When a gun is fired, the gun moves back to keep the momentum conserved.

Before fire, both gun and bullet are in rest. Total momentum is zero.

After the fire, bullet gets some momentum and moves forward. To keep the momentum conserved, the gun moves back.

Question 23: Why it is dangerous to travel on bus roof?

When brakes of bus are applied or bus takes a turn, the passengers on the roof tend to continue their previous motion in straight line due to inertia and may fall from roof. So, it dangerous to travel on the bus roof.

Question 24: When a bus takes a turn, why the people are forced outward?

When a bus takes a turn, the passengers on the roof continue their motion in straight line due to inertia, due to which the upper part of the body moves in opposite direction to the turn.

Question 25: What is meant by an isolated system?

An isolated system consists of mutually colliding objects in which there is no external force.

Note: Its momentum is always remains conserved.

Example: Gun and a bullet is an isolated system.

Question 26: What is Atwood machine or System? Write its use.

An Atwood machine or system is arrangement of two objects of unequal masses which are attached to the ends of a string which passes over a frictionless pulley.

USE: it is used to find the acceleration due to gravity.

Question 27: What is meant by friction? Write its advantages.

The force which opposes the motion of two surfaces on each other, is known as the friction.

Factors affecting the friction:

1) Angle on which two bodies are placed.
2) The force which presses one surface on the other.
3) Contact area or the contact point.

Unit of the friction is the newton, N.

Advantages of the friction:

1) It helps us in walking on the earth.
2) It helps to move and apply brakes of vehicles on road.
3) It helps us to write.
4) It helps the birds to fly.

Question 28: What is meant by the rolling friction?

When a body rolls on another body, the friction between them is known as the rolling friction.

Note: It is always less than the sliding friction.

Question 29: Why the rolling friction is always less than the sliding friction?

During rolling motion an objects rolls without breaking cold welds but during sliding motion due to breaking of cold welds resistive force increases due to which rolling friction is always less than sliding friction.

Question 30: what is limiting friction?

Maximum quantity of static friction is called limiting friction.

Question 31: What type of shoes are the best for jogging and why?

The shoes which have much contact with the earth are the best for the jogging. The shoes which have rough sole are used for the jogging to increase the friction.

Question 32: what happen if all types of friction are diminished?
Friction helps us a lot in everyday life. We do our most of the works due to the friction. If friction is diminished, the system is ruined.

Question 33: What is meant by the coefficient of friction? Write its numerical form?

The ratio of the limiting friction and the normal reaction force is known as the coefficient of the friction.

Numerical formula: $F_s = \mu mg$

It is unitless quantity.

Example:

1) The coefficient of friction between the tyre and the dry road is 1
2) The coefficient of friction between the tyre and the wet road is 0.2

Question 34: Write the disadvantages of the friction?

1) It causes an energy loss
2) It decreases the speed of the body by opposing the motion.
3) Due to the friction, the parts of the machine are rubbed and are damaged.

Question 35: Write ways to reduce friction?

1) By making the surfaces smooth.
2) By making structure fast vehicles streamline.
3) By lubricating the parts of the machine.

4) By converting the sliding into the rolling friction.

Question 36: Why friction reduced when oil is used between moving parts of machine?

By using oil between moving parts of machines cold welds or spaces are filled and moving surfaces become smooth due to which friction is reduced and parts move with ease.

Question 37: What is the purpose of the banking of the road?

The upper part of the road is higher than the lower this is known as the banking of the road.

To move a vehicle in a circle, we need centripetal force. When the one end of the road is made higher, the parallel components of the normal reaction force gives sufficient centripetal force to the vehicle.

Question 38: Define braking and skidding.

Braking: To stop the motion of wheels of vehicle is called braking.

Skidding: The motion of wheels of a vehicle without rotation is called skidding.

Question 39: Define centripetal force and write its numerical form?

The force which moves a body in a circular path, is known as the centripetal force. Its direction is always towards its center.

Formula:

$$F_c = \frac{mv^2}{r}$$

Example: Tie one end of the string with a stone. Now whirl it. The centripetal force on the stone is always acting towards its center.

Question 40: What is meant by the centrifugal force?

The reactional force which tends the body to move out of the circular path, is known as the centrifugal force.

Its direction is always away from the center of the circle.

Formula:

$$F_g = -F_c = -\frac{mv^2}{r}$$

Example: Tie one end of the string with a stone. Now whirl it. The centripetal force on the stone is always acting towards its center. Another force in the reaction of this which causes the body to move out of the circle, is known as the centrifugal force.

Question 41: I f a body is moving in a circle of radius r. What changes will occur to the centripetal acceleration if the velocity becomes twice?

As we know that:

$$ac = \frac{V^2}{r} ....(i)$$

Condition:

V=2v

$$ac^/ = \frac{(2V)^2}{r}$$

$$ac^/ = \frac{(4V^2)}{r}$$

$$ac^/ = 4\frac{V^2}{r}$$

From equation (i)

$ac^/ = 4ac$

Question 42: why spinner of washing machine revolves at high speed?

The dryer of washing machine consist of basket spinners with perforated walls having large number of fine holes. Its spinner is rotated at high speed so that water of wet clothes is forced out through holes due to centrifugal force.

Question 43: What is the working principle of the cream separator?

It works on the centrifuge machine principle.

Explanation: Cream separator is a high speed spinner. The milk is poured in it and the machine spins at very high speed. The heavier particles of the milk are separated at the outer side and

the lighter particles are moved towards the inner side of the machine. The inner part (cream) is separated by using pipes and heavier part by the walls of the machine.

Question 44: What are the reasons of slipping on wet surface?

There is less friction on a wet surface while walking on such a surface contact with earth decreases and slipping is increased.

CHAPTER 4: ROTATIONAL EFFECTS OF FORCE

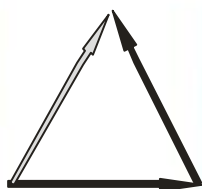
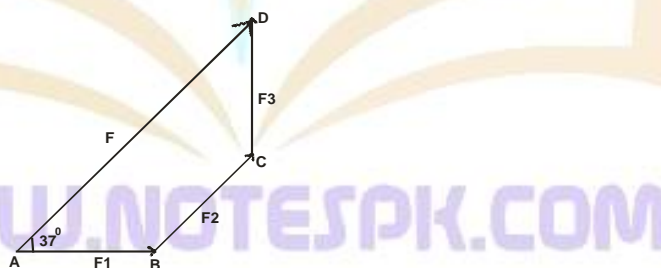
Question 1: What are parallel forces?

Forces which are parallel to each other are called parallel forces

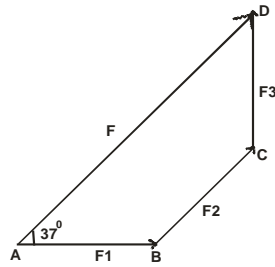
Question 2: What is the difference between the like and the unlike parallel forces?

Like parallel	Unlike parallel
1) The forces which are parallel and acting in the same direction are like parallel forces. **2) Example:** The weight of the apples in the bag is always in the downward direction.	1) The forces which are parallel and acting in the opposite direction are unlike parallel forces. **2) Example:** Weight of a stone hanging is always in downward direction but the tension in the string by which it is tied is always in upward direction.

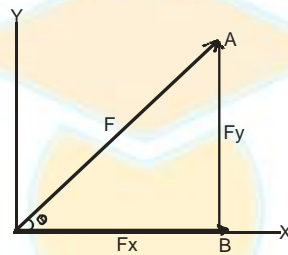
Question 3: What is meant by resultant vector? What is resultant force?

Resultant vector: The vector which is obtained by the sum of the two or more forces, is known as the resultant vector.

Resultant force: Force is vector quantity. After adding different forces, we get a single force which is known as the resultant force.

Question 4: Explain head to tail rule?

The graphical way of adding vectors is known as the head to tail rule.

Make vectors according to the selected scale. Attach two vectors such that the tail of the second vector is attached with the head of the first vector. Continue this process until all the vectors are arranged according to this way. Draw the resultant vector such that its tail is at the tail of the first vector and the head is at the head of the last vector.

Question 5: What is meant by the resolution of the force? Name its components.

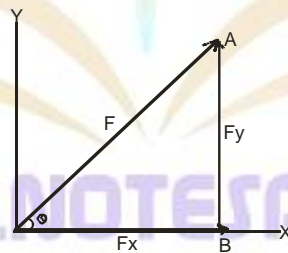
To divide a force into its perpendicular components is known as the resolution of the vector.

Components: Suppose a force is acting at an angle of θ with x-axis.

Horizontal component= $F_x = F\cos\theta$

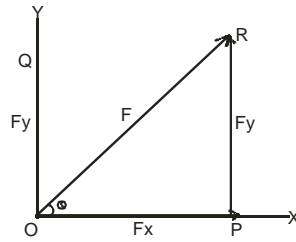
Vertical component= $F_y = F\sin\theta$

Question 6: Define perpendicular components?

The components of the forces which are perpendicular to each other are known as the perpendicular components.

They make an angle of 90°.

Horizontal component= $F_x = F\cos\theta$

Vertical component= $F_y = F\sin\theta$

Question 7: How a force can be calculated by using its perpendicular components?

The magnitude and direction of force (F) can be determined from right Triangle (OPR).

According to Pythagorean Theorem.

$(Hyp)^2 = (Base)^2 + (Perp)^2$

$F^2 = Fx^2 + Fy^2$

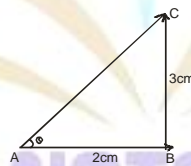
$$F = \sqrt{F_x^{\ 2} + F_y^{\ 2}}$$

The direction of force with x-axis:

$$Tan\theta = \frac{perp}{base} = \frac{PR}{OP}$$

$$Tan\theta = \frac{F_y}{F_x}$$

$$\theta = \tan^{-1}\left(\frac{F_y}{F_x}\right)$$

Question 8: A right angle triangle has base of 2 cm and perpendicular 3cm. What is the value of the hypotenuse?

According to Pythagorean Theorem.

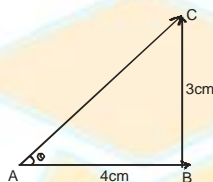
$$(Hyp)^2 = (Base)^2 + (Perp)^2$$

$$Hyp = \sqrt{(Base)^2 + (Perp)^2}$$

$$Hyp = \sqrt{(2)^2 + (3)^2}$$

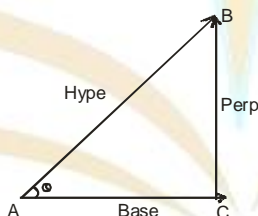
$$Hyp = \sqrt{4+9}$$

$$Hyp = \sqrt{13}cm$$

Question 9: In a right angle triangle base is 4cm and perpendicular is 3cm.find Tan

$$\tan\theta = \frac{perp}{base}$$

$$\tan\theta = \frac{3}{4}cm = 0.75cm$$

Question 10: What are trigonometric ratios?

Answer: The ratio between any two sides of the right angled triangle, is known as the trigonometric ratio.

Explanation:

$$Sin\theta = \frac{Perp}{Hype} = \frac{BC}{AB}$$

$$Cos\theta = \frac{Base}{Hype} = \frac{AC}{AB}$$

$$Tan\theta = \frac{Perp}{Base} = \frac{BC}{AC}$$

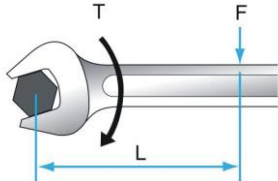
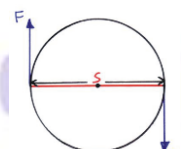
Question 11: What is meant by rigid body?

If the distance between any two points of a body remains same after applying any force, the body is said to be a rigid body.

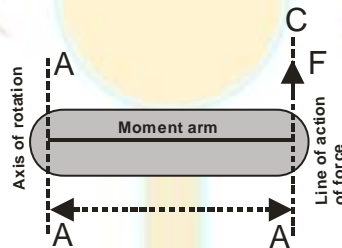
Explanation: It is such a body which don't change its shape when a force is applied.

Example: A foot-ball or a cricket ball.

Question 12: What is meant by moment arm and axis of rotation?

Moment arm: The perpendicular distance of the line of action of the force from the axis of rotation, is known as the moment arm. It is shown by L

Unit: Its unit is m

Axis of rotation: If a body is rotating about a line, its all Points moves in a circle whose center is at that line. This line is known as the axis of rotation.

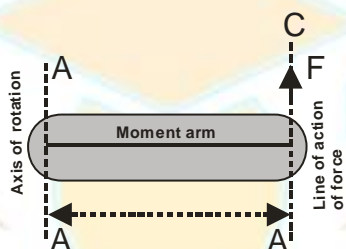
Diagram:

Question 13: Explain the difference between torque and couple and write units?

TORQUE	COUPLE
1) The rotational effect of a force is known as the torque or moment of the force.	1) Two unlike forces equal in magnitude but opposite in direction always produces a couple.
2) Diagram:	2) Diagram:
Formula: Torque T = F (Force) × L (Length)	**Formula**:
3) **Unit:** Its unit is Nm.	**3) Unit:** Its unit is N.

4) Torque depends upon the force and moment arm.	4) It depends upon the total torque and the moment arm.

Question 14: What is line of action of force?

The line along which acts is known as the line of action of force.

Diagram:

Question 15: What happened to the torque when we double the moment arm?

As we know that

$$\tau = F \times L \ldots\ldots\ldots..(i)$$

$$L = 2L$$

$$\tau^{/} = F \times 2L$$

$$\tau^{/} = 2(F \times L)$$

From equation (i)

$$\tau^{/} = 2\tau$$

Hence torque is doubled.

Question 16: What is meant by a moment of force? Explain the principle of the moments.

The rotational effect of the force is known as the moment of force.

Types of moment of the force:

1) Clockwise moment
2) Anti- clockwise moment

Principle of the moment: When a body is in equilibrium, the sum of all the clockwise and anti-clockwise moments is zero.

Which means, clockwise moment = anti-clockwise moment

Question 17: What is the difference between the clockwise and the anti-clockwise moments?

Clockwise moment	Anti-clockwise moment
1) The torque produced by a force which rotates a body in clockwise direction, is known as the clockwise torque. 2) It is often used to tight the nut **Diagram:** 	1) The torque produced by a force which rotates a body in anti-clockwise direction, is known as the anti-clockwise torque. 2) It is often used to lose the nut. **Diagram:**

Question 18: A 100 N force is acting at the 10 cm distance from the net on the spanner. What is the torque?

Given: **F=100 N**

Perp distance=moment Arm=L=10cm=10×10^{-2}m

Required: **Torque=** $\tau = ?$

Solution: According to formula of torque.

$$\tau = F \times L$$

$$= 100 \times 10 \times 10^{-2}$$

$$\tau = 10Nm$$

Question 19: A mechanic used 200N force on a spanner of 15cm long .find its torque.

Given: **F=200 N**

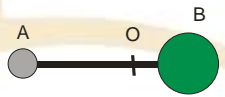
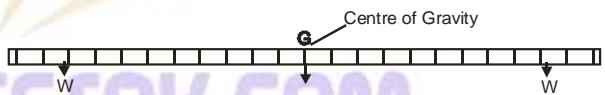
Perp distance=moment Arm=L=15cm=15×10^{-2}m

Required: **Torque=** $\tau = ?$

Solution: According to formula of torque.

$$\tau = F \times L$$
$$= 200 \times 15 \times 10^{-2}$$
$$\tau = 30Nm$$

Question 20: What will be torque if 150N force is applied on 10cm long spanner?

Given: **F=150 N**

Perp distance=moment Arm=L=10cm=10×10^{-2}m

Required: **Torque=** $\tau = ?$

Solution: According to formula of torque.

$$\tau = F \times L$$
$$= 150 \times 10 \times 10^{-2}$$
$$\tau = 15Nm$$

Question 21: Write the difference between the center of mass and center of gravity?

Center of mass	Center of gravity
1) A point of the system where a force translates or moves a body without making any rotation.	**1)** A point of a body where whole of weight of the body seems to act, is known as the center of gravity.
2) A system has a center of mass.	**2)** A body has a center of gravity.
3) It depends upon the mass of the system.	**3)** It depends upon the geometry of the body.
4) One system has only one center of mass.	4) One system can have more than one center of gravities.
5) **Figure:**	**5)** **Figure:**

Question 22: What is plumb line?

A plumb line consist of a small metal bob. When the bob is suspended freely by the string, it rests acting the vertical direction due to weight acting vertically downward.

Question 23: Where will be the center of gravity of a uniform square body and a uniform triangle?

Uniform square: It is at the point of intersection of the diagonals of the square.

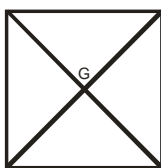
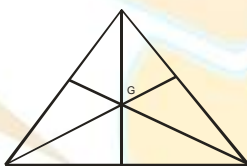
Figure:

Uniform triangle: It is at the point of intersection of the medians of the triangle.

Figure:

Question 24: How the center of gravity of an irregular thin sheet can be found?

It can be found by using a plumb line.

Procedure:

1) First of all, draw points A, B, C and D at the corners of the body.
2) Now, balance the body at point A on a wall nail, such that it can rotate freely.
3) By using plumb line, draw a line straight downward.
4) Now repeat the same procedure for all the points and draw a line straight downward for every point.
5) The intersecting point G of all these lines will be our center of gravity.
   So, G is our center of gravity.

Question 25: define equilibrium.

A body is said to be in equilibrium if no net force is acting on it.

Question 25A: when a body is in the state of equilibrium?

A body is in the state of equilibrium if:

1) No force is acting on it or resultant of forces acting on it is zero.

2) Net torque acting on it is zero.

Question 26: Write the conditions of equilibrium? Write their mathematical form.

First condition of the equilibrium: The sum of all the forces acting on the body is zero.

Numerical form: **1st Condition:**

Let suppose forces F_1,F_2,F_3,F_4…………………………..F_n are acting on a body so that

$F_1+F_2+F_3+F_4+$……………………………..$+F_n = 0$

$$\sum F = 0$$

Example:

1) A book on the table.
2) A frame hanging with the wall.

Second condition of the equilibrium: The sum of all the torques acting on the body is zero.

Numerical form:

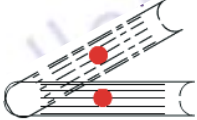
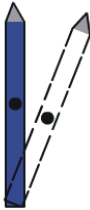
$$\sum \tau = 0$$

Example:

1) A fan rotating with uniform speed
2) Motion of the earth.
3) A ladder rest on the wall.

Question 27: Tell about the body which is at rest but not in equilibrium?

When a body freely moving upward. After reaching highest point, the body becomes at rest. But still gravity is acting on it. Due to which body is not in equilibrium according to the first condition of the equilibrium.

A man sitting in a moving vehicle is at rest but not in equilibrium.

Question 28: Give an example of a body which is moving but still is in the equilibrium?

A paratrooper moving downward in the air is moving with constant velocity but is in equilibrium.

Question 29: Why the body cannot be in equilibrium under the action of the single force?

A force always produces acceleration in the body. Under the action of the single force, the body cannot be in equilibrium because sum of the force is not zero in this case.

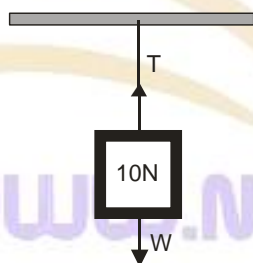
Question 30: What is the difference between the stable and the unstable equilibrium?

<table>
<tr><th>Stable Equilibrium</th><th>Unstable Equilibrium</th></tr>
<tr><td>1) After the action of the slight disturbance, if a body comes back to its original state. The body is in stable equilibrium.
2) Center of gravity is as low as possible.
3) A body remains in stable equilibrium till its center of gravity remains in its base.
4) A book lying on the table.
</td><td>1) After the action of the slight disturbance, if a body does not come back to its original state. The body is in unstable equilibrium.
2) Center of gravity is maximum in this case.
3) It occurs when the center of gravity comes out of its base.
4) A pencil balanced on its nib.
</td></tr>
</table>

Question 31: Define the neutral equilibrium?

After the action of the slight disturbance, if a body does not come back to its original state while it becomes stable on another new state. The body is in neutral equilibrium. The center of gravity in this case does not change its position.

Examples: Ball, Bowl**,** Egg**,** roller

Question 32: A block with a weight of 10 N is hanging with a string. Find the tension in the string?

Given: Weight of block =w=10N

Required: Tension in string =T=?

Solution: Hence block is at rest, so according to the first condition of equilibrium

$$\sum F_x = 0$$

No force can acts on x-axis. While acting forces on y-axis are (W) and (T).

$$\sum F_y = 0$$

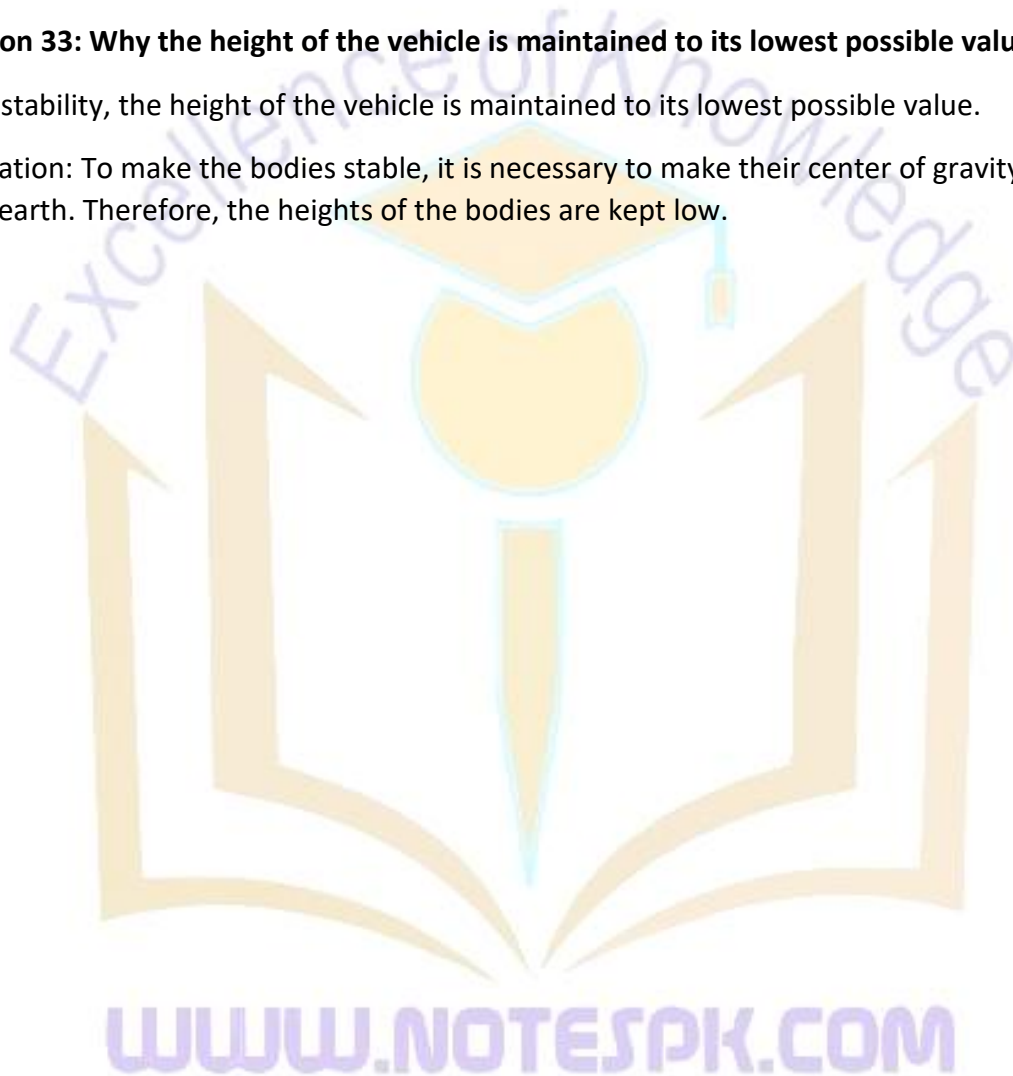
T-W=0

T=W

T=10 N

Question 33: Why the height of the vehicle is maintained to its lowest possible value?

To get stability, the height of the vehicle is maintained to its lowest possible value.

Explanation: To make the bodies stable, it is necessary to make their center of gravity nearest to the earth. Therefore, the heights of the bodies are kept low.

CHAPTER 5: GRAVITATION

Question 1: What is meant by the force of gravitation?

The force by which every object of this universe is attracting other objects towards its center, is known as the force of the gravitation.

Importance: Every object in this universe is attracting other towards its center. Due to this the moon is revolving around the earth and all planets around the sun.

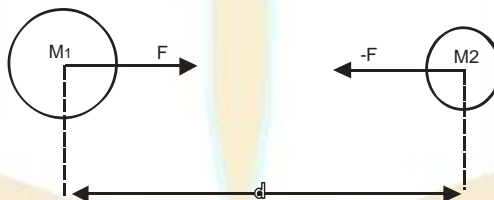
Note: The weight of a body is also because of the force of gravitation of earth.

Question 2: Explain the law of gravitation?

Every object in this universe is attracting other towards its center by a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers.

NUMERICAL FORM:

$$F = G\frac{M_1 M_2}{d^2}$$

DIAGRAM:

Question 3: What is the value of G in the law of the gravitation? Write its units?

G is a constant in this law which is known as the gravitational constant.

Formula:

$$F = G\frac{M_1 M_2}{d^2}$$

Unit: Nm^2Kg^{-2}

Value: $G = 6.673 \times 10^{-11} Nm^2 kg^{-2}$

Question 4: Why we don't feel any effects of gravitational force around us?

Due to the very small value of “G” ($G = 6.673 \times 10^{-11} Nm^2kg^{-2}$) around us, we cannot feel the effects of the gravitational force around us.

Question 5: What is relationship between law of gravitation and Newton’s third law of motion?

According to Newton’s third law every action has a reaction which is equal in magnitude but opposite in direction. On the other hand action and reaction due to gravitational force of attraction are equal in magnitude but opposite in direction this is according to Newton’s third law.

Question 6: Why the law of gravitation is so much important for us?

1) The law tells us the reasons of the certain orbital rotation of the planets.
2) The law tells us the weight of any object on the earth and the rotation of the earth around the sun.
3) It helps us for studying satellites and modern technology

Question 7: With how much force an apple of the 1N weight attracts the earth towards itself?
According to the law of the gravitation, an object attracts other objects towards itself by a force equal to its weight. So, the apple will attract the earth by a force equal to the force of 1N (its weight).

Question 8: Do you attract the earth or the earth attracts you?

According to the law of the gravitation, every object attracts other object towards itself by a force equal to its weight.

Note: The earth attracts us towards its center by a force equal to its weight and in the reaction of this force we also attract the earth towards ourselves by a force equal to our weight.

Question 9: What is field force?

A non-contact force which attracts the body in space at different points, is known as the field force.

Note: Field is a vector. Field is a region around the object where other objects feel a force of gravity.

Example: The earth attracts the things wither they are in contact with earth or not.

Question 10: What is a strength of the gravitational field?
A gravitational force of earth per unit mass at any point is known as the force of field of the earth.

Value: Its value is 10N/kg

Question 11: How can you say that the gravitational force is a field force?

Field force is non-contact force and gravitational force is also a non-contact force.

Explanation: When a body is thrown upward, its velocity decrease. But when the body is thrown downward, its velocity increases whether the body is in contact with the earth or not. Therefore, it is known as the field force.

Question 12: What is meant by the gravitational field?

A region around the earth where an object can feel the force of gravity of earth, is known as the gravitational field of the earth.

Note: Earth attracts every object with a force of 10N/kg.

Question 13: What is the direction of gravitational field?

The direction of gravitational field is always towards the Centre of earth.

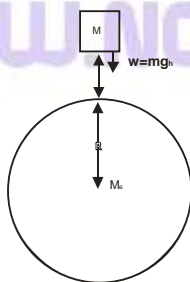
Question 14: Why the value of "g" decreases with the height?

Answer: Value of "g" depends on radius of earth "R". Value of "g" is inversely related to the square of radius of earth & it decreases with altitude. Value of "g" can be determined at height "h" by using.

$$g_h = G\frac{M_e}{(R+h)^2}$$

Where "h" is height from earth-surface. Equation shows that value of g becomes one-fourth at height equal to radius of earth. Similarly it becomes 1/9 at height equal to 2R.

Question 15: Write the equations of the gravitational acceleration according to the Newton's law of gravitation at the height of "h" from the earth.

Answer:

Let a body having mass m is at height "h "from surface of Earth. Its distance from Earth-surface is (R+H). The value of gravitational acceleration at height "h" can be determined by:

$$g_h = G\frac{M_e}{(R+h)^2}$$

Question 16: Why the value of "g" changes with the position or why the value of "g" changes with the height"h"?

Value of "g" depends on radius of earth "R". Value of "g" is inversely related to the square of radius of earth & it decreases with altitude. Value of "g" can be determined at height "h" by using.

$$g_h = G\frac{M_e}{(R+h)^2}$$

Where "h" is height from earth-surface. Equation shows that value of g becomes one-fourth at height equal to radius of earth. Similarly it becomes 1/9 at height equal to 2R.

Question 17: Write the equations for finding the mass of earth?

To find the mass of Earth use this equation:

$$M_e = \frac{R^2 g}{G}$$

Question 18: Write the value of Radius of Earth and G.

$$G = 6.673 \times 10^{-11} Nm^2 kg^{-2}$$ R=6400km

Question 19: If the value of R is doubled, what changes will occur in the equation $g=Me/R^2$?

$$g = G\frac{M_e}{(R)^2}$$

If R=2R

$$g = G\frac{M_e}{(R)^2}..................(i)$$

$$g' = G\frac{M_e}{(2R)^2}$$

$$g' = G\frac{M_e}{4R^2}$$

$$g' = \frac{1}{4}\left(\frac{GM_e}{R^2}\right)$$

$$g' = \frac{1}{4}(g)$$

Question 20: What is the value of "g" on Sun and Mars?

Value of"g" on the Sun: 274.2 ms^{-2}

Value of"g" on the Mars: 3.73 ms^{-2}

Question 21: What is distance of moon from earth and in how many days moon completes its one trip around earth?

Moon is at the distance of 3,80,000km from earth. It completes its one trip around earth in 27.3 days.

Question 22: What is a satellite and what is meant by geo-stationary satellite?

Satellite:

A body which revolves around any planet is known as its satellite.

Types: (1) Natural satellite (2) Artificial satellite.

Geo-stationary satellites: Those satellites which are at rest with respect to earth, are known as the geo-stationary satellites.

1) It completes its one trip in 24 hours around the earth.
2) Its orbit is known as the geo-stationary orbit.
3) They are three in numbers.

Question 23: What is the difference between the natural and artificial satellites?

Natural satellites	Artificial satellites
1) Those satellite which are naturally revolving around the earth, are known as the natural satellites. **2)** Moon around the earth.	**1)** Those satellites which the scientists have launched for communication and other purposes. **2)** Artificial satellite which revolves around the earth for communication.

Question 24: Why the communication satellites are launched in the stationary orbit?

They are launched for the following purposes:

1) Communication.
2) Military purposes.
3) To find the resources under the earth surface.

Question 25: What is meant by the geo-stationary orbit?

The orbit of the geo-stationary satellite is known as the geo-stationary orbit.

Question 26: Write the speed and height of the geo-stationary satellites from the earth?

Height: Their height is 42300 km.

Speed: Their speed is zero with respect to the earth because their time period is the same as that of the earth around its center.

Question 27: On what factors does the rotation of the satellite around the earth depend?

Answer: Rotation of satellites around earth depends on its height, orbital speed and centripetal force.

Question 28: What is meant by navigation system or what is GPS?

it stands for global positioning system. It consists of 24 satellites.

Speed: They revolve around the earth two times a day with a speed of 3.87 km/s.

Navigation system helps us in finding position on the earth surface or in the air. It also helps in map making.

Question 29: Write down the formula for the orbital speed of the artificial satellites.

Answer:

$V = \sqrt{gR}$ is the formula for orbital speed of artificial satellites

Question 30: What is the speed of the satellite rotation in lower orbit?

Answer: The speed of satellite rotation in lower orbit is $8 kms^{-1}$ or $29000 kmh^{-1}$

CHAPTER 6: WORK AND ENERGY

Question 1: When a force does work?

When a force has some magnitude and the body move some distance in the direction of the force, then we say that the force has done some work.

Question 2: Define work and write its formula and units?

When a force acts on a body and the body covers some distance in the direction of the force, then the body has some work.

Formula: $W = FS\cos\theta$

The product of the force and the distance covered in the direction of the force, is known as the work.

Unit: Its unit is J or Nm.

It depends upon the force, displacement and the angle between them.

Question 3: What is the unit of work or the energy in SI system? Define it.

Unit of work or energy is joule (J).

It is the work which the force of one Newton does in moving a body one meter in its own direction

Question 4: A man pulls a cart by applying 300N force and moves 35m.what will be its work?

Given: F=300N

Distance = S=35m

Required: work =?

Solution:

W=FS

W= (300) (35)

W=10500J

Question 5: What will amount of work to lift a brick of 2kg to the height of 5m?

Given: mass of brick=m=2kg

Height=h=5m

Required: **Work=W=?**

Solution: **W=P.E=mgh**

W= (2) (10) (5)

W=100J

Question 6: Define energy and write its some sources?

Ability of a body to do work is known as the energy.

Sources: Wind, Water, Sun, Fossil fuels, Nuclear energy

Question 7: Write any of the five types of the energy?

1) Mechanical energy.
2) Electrical energy
3) Solar energy
4) Sound energy
5) Heat energy
6) Chemical energy

Question 8: Define mechanical energy and write its types.

Energy stored in a body due to its motion or position or both is called mechanical energy.

Types: It has two types (1) Kinetic energy (2) Potential energy

Question 9: Why we need energy?

We need energy to perform work of everyday life.

Question 10: What is kinetic energy? Write its formula.

The energy of a body due to its motion is known as the kinetic energy.

Formula: $$K.E=\frac{1}{2}mv^2$$

It depends upon the mass and velocity of the body.

Example: (1) Water flowing in canal **(2)** Wind blowing

Question 11: A car of 12kN has a velocity of 20m/s. Find its kinetic energy?

Given: **weight of car=W=12KN=12×10^{3}N**

Speed of car=V=20ms^{-1}

Required: **K.E=?**

$$K.E = \frac{1}{2}mv^2$$

$$W = mg$$

$$m = \frac{w}{g}$$

$$K.E = \frac{1}{2}\left(\frac{w}{g}\right)v^2$$

$$K.E = \frac{1}{2}\left(\frac{12\times10^3}{10}\right)(20)^2$$

$$K.E = \frac{6\times10^3}{10}\times400$$

$$K.E = 240\times10^3\,J$$

$$K.E = 240KJ$$

Question 12: A stone has a mass of 500g. It collides with earth with a velocity of the 15m/s. What is its kinetic energy at the time of the collision?

Given: **mass=500g=0.5g**

Velocity=V=15ms^{-1}

Required: **K.E=?**

Solution:

$$K.E = \frac{1}{2}mv^2$$

$$K.E = \frac{1}{2}(0.5)(15)^2$$

$$K.E = \frac{1}{2}(112.5)$$

$$K.E = 56.25J$$

Question 13: A 2kg body has kinetic energy of 25J. What is its velocity?

Given: mass=2kg

K.E=25J

Required: Speed=V=?

Solution:

$$K.E = \frac{1}{2}mv^2$$

$$25 = \frac{1}{2}(2)v^2$$

$$25 = v^2$$

$$\sqrt{25} = \sqrt{v^2}$$

$$v = 5ms^{-1}$$

Question 14: A stone has a mass of 500g. It collides with earth with a velocity of the 20m/s. What is its kinetic energy at the time of the collision?

Given: mass=500g=0.5g

Velocity=V=20ms^{-1}

Required: K.E=?

Solution:

$$K.E = \frac{1}{2}mv^2$$

$$K.E = \frac{1}{2}(0.5)(20)^2$$

$$K.E = \frac{1}{2}(0.5)(400)$$

$$K.E = 200 \times 0.5$$

$$K.E = 100J$$

Question 15: Define potential energy and write its formula?

The energy of the body due to its position is known as potential energy.

Formula: P.E = mgh

Examples:

1) The energy of stored water in the dam
2) The energy stored in the rubber when it gets some force.

Question 16: What is the difference between the sound energy and the mechanical energy?

Sound energy	Mechanical energy
1) Energy due to the vibrations in the body is known as the sound energy. **2) Examples:** Breaking of a cup. Diaphragm of the drum	**1)** The energy due to the motion of the body is known as the kinetic energy. **2) Examples:** Water flowing through the canal Energy of a moving motor bike.

Question 17: How can be the mechanical energy converted into the heat energy?

When we rub our hands, the mechanical energy is converted into the heat energy.

Note: When we rub our hands, we actually move our hands and friction causes some energy to lose in the form of heat energy.

Question 18: What is meant by the chemical energy?

The energy due to the chemical reaction in a body is known as the chemical energy.

EXAMPLES:

1) The energy obtained in the form of heat, sound and the light when we burn coal, natural gas and other fuels, is actually obtained from the chemical energy of the materials.
2) When the bonds between the atoms are broken, energy is obtained.

Question 19: What is meant by the nuclear energy?

The energy obtained as a result of the nuclear reactions, is known as the nuclear energy e.g. Energy in the sun.

Note: Fission and the fusion reactions are included in the nuclear reactions. They have heat, light as well as the nuclear radiation in them.

Question 20: What is fission reaction?

The process to get energy by breaking nucleus of an atom is called fission reaction.

Question 21: What is meant by the electrical energy and the light energy?

Electrical energy: The energy due to the moving charges is known as the electrical energy.

Note: Electricity has huge use and it is transferred by using wires.

Sources: It is stored in the batteries or produced by using generators.

These generators work in the plants like hydro, nuclear or thermal power plant.

Light energy: Light is a type of the energy which helps us in seeing all the objects of the universe.

Note: When an electron jumps from an orbit of the higher energy to the orbit of the lower energy, energy in the form of light is released.

Source: Sun is the biggest source of the light.

Question 22: What is meant by soil erosion?

Flowing water wash away soil particles of rocks this process is called soil erosion.

Question 23: How energy is converted from one form to the other?

Energy can be converted from one form to the other but the total energy remains same.

The natural processes cause the inter-conversion of the energy.

1) When we rub our hands, the kinetic energy is converted into the heat.
2) When electricity passes through the bulb, the electrical energy is converted into the heat and the light.
3) The water gets heat from the sun and converted into the vapors, the energy is stored in these vapours in the form of the potential energy. When this water passes through the cool region, the potential energy is converted into the mechanical energy.

Question 24: Tell five devices which convert mechanical energy into electrical and the electrical into the mechanical?

Devices which convert mechanical into electrical:

1) Generator
2) Wind turbine
3) Dynamo
4) Steam engine
5) Internal combustion engine

Devices which convert electrical energy into mechanical:

1) Electric motor
2) Electric fan
3) Washing machine
4) Electric car

5) Pump

Question 25: What are the renewable and non-renewable resources?

Renewable resources: The sources which can be reproduced after some time, are known as the renewable resources.

Examples:

1) water
2) Dairy products

Non-renewable resources: The sources which cannot be reproduced after a period of time, are known as the non-renewable sources. It requires several million years.

Examples:

1) Petrol
2) Natural gas, coal, wood and fossil fuels.

Question 26: Why the fossil fuels are called as the non-renewable resources?

Because the fossil fuels cannot be reproduced in a short period of time. They required millions of years to be produced.

Note: They are produced when the remaining of the plants and trees are buried under the earth surface and the heat and the pressure change them into the fossil fuels.

Question 27: Write the uses of fossil fuels.

Fossil fuels are used as fuel in houses, vehicles and industries. They are also used in power plants to generate electricity.

Question 28: What are disadvantages of fossil fuels?

1) Due to burning of fossil fuels waste products like carbon dioxide, carbon mono oxides etc. are produced which may cause health problems.
2) Due to burning of fossil fuels thermal pollution is produced due to which temperature of atmosphere increases.

Question 29: How energy is gained through the nuclear fuels?

The minerals through which nuclear energy is gained, are known as the nuclear fuels.

These minerals are used in nuclear power plants to get a great amount of the energy. They produce a great amount of the nuclear radiations.

Note: During the nuclear fission reaction, the nucleus of Uranium breaks into two smaller and lighter nucleus. Another type of process is named as the fusion reaction through which energy can be gained.

Question 30: What is meant by the muscular energy?

Muscular energy is actually the kinetic energy which is converted into the heat energy when we rub our hands.

Muscular energy is obtained by the breakdown of food we eat.

Question 31: Which type of energy is preferred on the other types of the energy?

Solar energy is preferred over all other types of energy because it is environment friendly and readily available in large quantity.

Question 32: Write the names of the components of the solar heating system?

This system is used to keep house and offices warm by using the heat energy of the sun.

Components:

1) Collector
2) Storage device
3) Distribution system

Question 33: What is the second name of solar cell? How it is made?

Solar cell is also known as photo-cell. It is made of silicon wafers when they are exposed to light they convert light energy of sun into electricity, directly.

Question 34: Write some uses of the wind mills?

1) They are used to convert the wind energy into the electrical energy.
2) They are used to pump water.
3) They are used in the flour mills.

Question 35: Why we make the geothermal wells?

In the depth of the earth, the hot part of the earth magma is present which melts the rocks. The parts of the earth surface where the magma is not much deeper, the wells are made. Through the well, water is poured into the earth. The heat of the magma changes the water into the steam. This steam is used to keep homes and offices warm and also for the production of the electricity.

Question 36: Define magma and explain the geothermal energy?

Magma: The molten hot part of the earth crust is known as the magma.

Geothermal energy: The water near the magma layer is converted into the steam due to the heat. This energy under the surface of the earth is known as the geothermal energy.

Question 37: What is meant by the bio mass energy?

It consists of the all salts, urine of live stocks and upper layer of the vegetables and the dead plants/trees. Bio mass is used as the fuels in the power plants which produces electricity. The urea of the live stocks and the decomposition of the dead bodies of the plants and the animals produce the mixture of the carbon dioxide and methane. By burning methane, power plants make electricity.

Question 38: What is meant by the energy equation?

In 1905, the Einstein proposed that with a little change in the mass, a great amount of the energy can be obtained. He set an equation which is known as the equation of the energy or energy mass equation.

Equation: $E=mc^2$

In this equation, m is mass, E is energy and c is the velocity of the light.

Note: Energy obtained from the nuclear power plants is based upon the energy mass equation of the Einstein.

Question 39: Make a flow diagram of the energy converter for the electric lamp?

Answer:

Question 40: Write the disadvantages of the thermal pollution?

Pollution due to the heat, smoke and the dangerous gases, is known as the thermal pollution.

Disadvantages:

1) It causes the disturbance in the balance of natural life.
2) It causes a great danger to some of the animal species.
3) It causes a great change in the earth temperature and causes global warming.

Question 41: How can a person helpful in getting rid of the pollution?

Answer: A person can be helpful in getting rid of pollution by:

1) **Using public transport**
2) **By growing plants and trees**

Question 42: What is meant by the efficiency of a system? Write its formula.

It is the ratio of the output energy gained through the system to the input energy that is given to the system.

Formula: **Efficiency%=**$\frac{Required\ out\ put\ form}{Total\ input\ energy}$**×100**

Note: An ideal system gives output equal to the input.

Question 43: Is it possible to design such a system whose efficiency is 100%?

Each system has friction in it which causes some loss in the input energy in the form of the heat and the sound energy. It means that we cannot make use of the total energy we have given to the system. So, a system cannot have efficiency 100%.

Note: Output is always less than the input energy.

Question 44: A cyclist does useful work of 12J for each 100J. What is its efficiency?

Given: **input=100 J**

Output=12 J

Required: **Efficiency=?**

Solution: **Efficiency=**$\frac{output}{input}$

Efficiency=$\frac{12}{100}$

Efficiency=0.12

Efficiency %=0.12×100

Efficiency %=12%

Question 45: What is meant by the power? Write its formula and units.

Power: Work done per unit time is known as the power.

Formula: P=w/t

Unit: Its unit is watt or J/s, Nm/s.

Quantity: It is a scalar quantity.

Question 46: What is the SI unit of the power? Define it.OR Define Watt.

The SI unit of power is watt (W).

Watt: If a body does a work of one joule in one second, then the body has power of one watt.

Question 47: I f a machine works 9J in 3s. What is its power?

Given: **time=t=3s**

Work=W=9J

Required: **Power=P=?**

Solution:

$$P = \frac{w}{t}$$

$$P = \frac{9}{3}$$

$$P = 3watt$$

Question 48: A machine does a work of 20 J in 10 s. What is its power?

Given: **time=t=10s**

Work=W=20J

Required: **Power=P=?**

Solution:

$$P = \frac{w}{t}$$

$$P = \frac{20}{10}$$

$$P = 2watt$$

Question 49: A machine works 20J in 4s. What is its power?

Given: time=t=4s

Work=W=20J

Required: Power=P=?

Solution:

$$P=\frac{w}{t}$$

$$P=\frac{20}{4}$$

$$P=5watt$$

Question 50: If a body works 11200J in 10 s. What amount of power it has?

Given: time=t=10s

Work=W=11200J

Required: Power=P=?

Solution:

$$P=\frac{w}{t}$$

$$P=\frac{11200}{10}$$

$$P=1120watt$$

Question 51: A machine works 4J in 2s. Find its power.

Given: time=t=2s

Work=W=4J

Required: Power=P=?

Solution:

$$P = \frac{w}{t}$$

$$P = \frac{4}{2}$$

$$P = 2watt$$

Question 52: A body of 50kg mass is lifted to height of 3m. Find its potential energy? Where g=10m/s².

Given: **mass=m=50kg**

Height=h=3m

G=10ms^{-2}

Required: **P.E=?**

Solution: **P.E=mgh**

P.E= (50) (10) (3)

P.E=1500 J

Question 53: Convert a kilo watt hour into horse power.

1(kW) =1000w

1hp=746w

1(kW) $= \frac{1000}{746}$ hp

1(kW) =1.34hp

Question 54: How can we get energy from wind?

Wind energy is obtained by the kinetic energy of the wind.

Procedure: Wind turbines are used to do so. There are several turbines packed together in the wind mill. Due to the kinetic energy of the air, the turbines revolve and convert the mechanical into the electrical energy.

It consists of 80 feet long pole on which several fans like structure are placed. When the air collides with the turbines, the turbines starts moving. The generators are attached with the turbines which produces electricity.